


HARVARD
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Evaluating Ingredients and Product Labels of Nail Polishes to Inform Safer Alternatives

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Public Workshop on Potential Health and Safety Impacts of Chemicals in Nail Products
Webinar, March 2, 2017

OUTLINE

- Nail Salon Industry
- Chemical Hazards
- Current Studies
- Preliminary Results
  - Nail Polish Ingredients & Labeling
- Future Studies

U.S. Nail Salon Industry

- $9 billion industry
- 130,000 nail salons
- 400,000 licensed nail salon technicians

(US Nails 2015)

NAIL SALON INDUSTRY

Revolution of nail procedures, nail polish finishes, nail art, and brands

NAIL SALON INDUSTRY

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Vulnerable Workers

- Small businesses
- Mostly female (97%)
- Young workers (43% aged 40 or below)
- Majority immigrant (63%)
- Low education
- Limited training
- Complex chemical mixtures

(US Nails 2015, NIOSH 2017)

Little Controls in Many Nail Salons

- Surgical masks
- No gloves
- Little ventilation

(Roelofs and Do 2012; Basch et al. 2016)

NAIL SALON INDUSTRY

New York Times, May 2015

“The Price of Nice Nails”

- Underpaid and exploited
- Ethnic bias and other abuse

“Perfect Nails, Poisoned Workers”

- Reproductive problems
- Cancer
- Lung disease
- Nose bleeds
- Skin conditions

NAIL SALON INDUSTRY

Limited Research has Associated Nail Salon Work with:

- Skin irritation
- Respiratory conditions
- Headaches
- Neurological problems
- Maternal complications

(Roelofs et al. 2008; Harris-Roberts et al. 2011; Sasseville 2012; Quach et al. 2015)

Volatile Organic Compounds (VOCs)

Nail polish, removers, glues

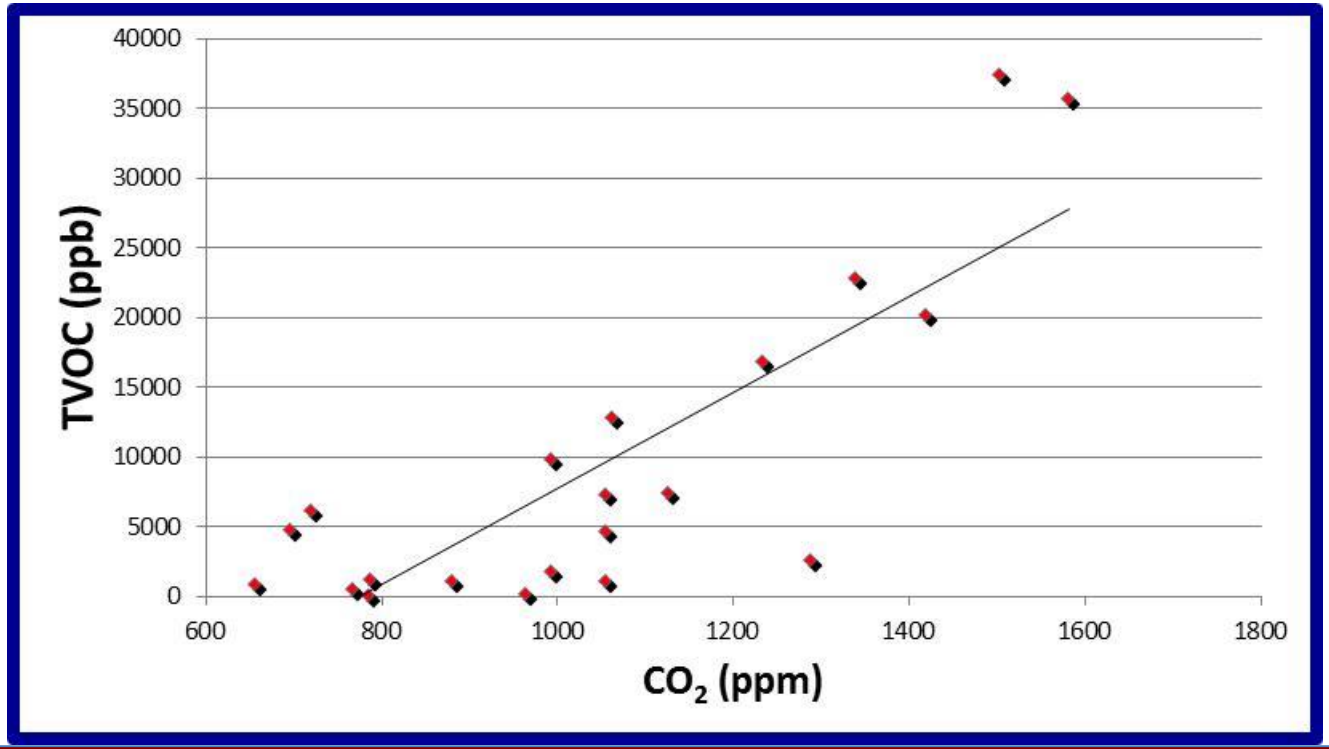
- Toluene
- Acetonitrile
- Acetone
- Isopropyl acetate
- Ethyl acetate
- Butyl acetate
- Formaldehyde

Studies Have Assessed Exposures to VOCs

- Levels often well below occupational exposure limits despite strong odors
  (NIOSH 1992a,b, 1998; Tsigonia et al. 2010; Quach et al. 2011; Alaves et al. 2013)
- Toluene mean air concentrations of 84ppb (GSD=1.2, n=6)
  (Garcia et al. 2015)

Exposures to VOCs and Ventilation

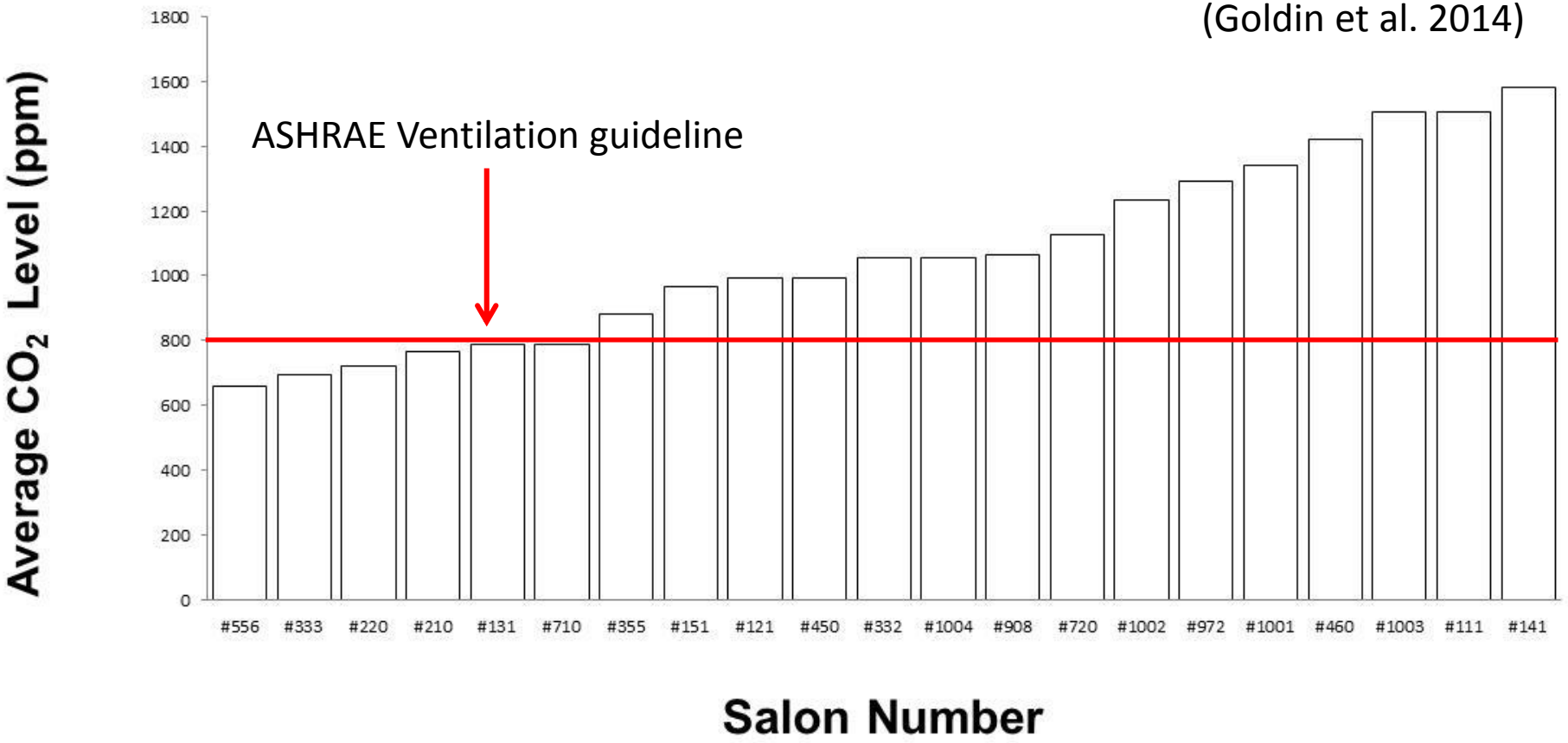
- Exposure to total VOCs (TVOC) was associated with lower ventilation in Boston area nail salons (Goldin et al. 2014)



Exposures to VOCs and Ventilation

- Most Boston area nail salons did not meet ASHRAE minimum ventilation requirements

(Goldin et al. 2014)



Semi Volatile Organic Compounds (SVOCs)

Plasticizers in nail polish

- Phthalates
  - DBP: dibutyl phthalate*
  - DMP: dimethyl phthalate*
  - DEP: diethyl phthalate*
- Other plasticizers
  - TPHP: triphenyl phosphate
  - ?

***Not commonly disclosed in new products**

Few Studies Have Assessed Exposures to SVOCs

- Much higher air concentrations of DEP and DBP occur in nail salons compared to other indoor environments (Tran and Kannan 2015)
- DBP exposure was higher in salon workers compared with: (Hines et al. 2009)
  - Other workers
  - General US population
- DBP metabolites in urine increased from pre- to post-shift in nail salons (Kwapniewski et al. 2008)

Dermal Contact to Plasticizers Matters

- Metabolite levels in urine to DBP in nail salon workers have been shown to decrease with the use of gloves

  (Kwapniewski et al. 2008)
- Self-application and wearing of nail polish containing TPHP leads to dermal exposure

  (Mendelsohn et al. 2016)

Metal Contaminants in Nail Polish

- Metal traces from pigments and colorants
  - Lead, cadmium, nickel, manganese, chromium, arsenic, cobalt, mercury in parts per million levels

  (Ouremi&Ayodele,2014; Borowska&Brz.ska,2015; Sipahi et al., 2015; Iwegbue, 2016; Bocca et al., 2014; Perkin Elmer, 2012)
- Any effect from the increase in metallic and shimmer finishes?



Research Objectives

- Understand exposures to chemicals that may affect reproductive health
  - VOCs
  - SVOCs
  - Metal contaminants
- Understand how chemicals get into the body: inhalation? dermal absorption?
- Understand sources of the chemicals

Nail Polish Ingredients and Labels

Young et al. 2016, EHS Fest Poster

Young A, science blog: https://sites.sph.harvard.edu/hoffman-program/2017/02/22/the-continual-regrettable-substitution-of-nail-polish-ingredients/

Review of Ingredient Information from 20 Brands

Safety Data Sheets (SDS):

- Inadequate ingredient information
- Trade secrets or “proprietary formula”
- Not always accessible online

Consumer product ingredient lists:

- Often more helpful than SDS
- “Colorants” and “fragrance”
- >200 unique ingredients

MATERIAL SAFETY DATA SHEET Page 2 of 8

Prepared to OSHA, ACC, ANSI, NOHSC, WHMIS & 2001/58 EC Standards | MSDS Revision: 1.6 | MSDS Revision Date: 03/17/2010

3. COMPOSITION & INGREDIENT INFORMATION

CHEMICAL NAME(S)	CAS No.	RTECS No.	EINECS No.	%	EXPOSURE LIMITS IN AIR (mg/m³) ACGIH ppm TLV	ACGIH ppm STEL	NOHSC ppm ES-TWA	NOHSC ppm ES-STEL	NOHSC ppm ES-PEAK	OSHA ppm PEL	OSHA ppm STEL	OSHA ppm IDLH	OTHER
BUTYL ACETATE	123-86-4	AF7350000	204-658-1	≤ 50.0	150	200	150	200	NF	150	200	1700	150 TWA
PROPRIETARY FORMULA	NA	NA	NA	BAL	NA	NA	NF	NF	NF	NA	NA	NA	

INGREDIENT LISTING

Butyl Acetate, Bis-HEMA Poly(1,4-Butanediol)-22/ IPDI Copolymer, Cellulose Acetate Butyrate, PPG-5 Methacrylate, Tetrahydrofurfuryl Methacrylate, Di-HEMA Trimethylhexyl Dicarbamate, Silica, Hydroxypropyl Methacrylate, Phenyldimethoxyacetophenone.

May Contain: Hydroxycyclohexyl Phenyl Ketone, Ethyl Trimethylbenzoyl Phenylphosphinate, Mica, Titanium Dioxide, Trimethylbenzoyl Diphenylphosphine Oxide, Polybutylene Terephthalate, Acrylates Copolymer, Ethyl Acetate, Calcium Sodium Borosilicate, Polyacrylate-4, Polyacrylate-5, Ethylene/VA Copolymer, Nitrocellulose, Tin Oxide, Isopropyl Alcohol, Colophonium (Rosin) (Colophane), Alumina, n-Butyl Alcohol, Drometrizole, Polyethylene Terephthalate, Isobutylphenoxy Epoxy Resin, Barium Sulfate, Synthetic Fluorphlogopite, Ethyl Pyrrolidone, Isotridecylcarbamatotolyl Aminohexylurea, Colorants.

Review of Ingredient Information from 20 Brands

Product Labels:

- Companies are removing certain ingredients of concern
- "3-Free" to "10-Free": exclusion of 3 to 10 ingredients
  - "3-Free" = free of the Toxic Trio: DBP, Toluene, and Formaldehyde

Current Product Labels

Nail polish product label

Ingredients reported to exclude

	3-Free	4-Free	5-Free	6-Free	7-Free		8-Free	9-Free		10-Free
Toluene	X	X	X	X	X *or*	X	X	X *or*	X	X
Dibutyl phthalate	X	X	X	X	X	X	X	(X)	X	X
Formaldehyde	X	X	X	X	X	X	X	X	X	X
Camphor		X	X	X	X	X	X	X	X	X
Tosylamide/formaldehyde resin			X	X	X	X	X	X	X	X
Nitrocellulose				X						
Xylene					X	X	X	X	X	X
Methyl ethyl ketone					X					
Parabens						X		X		X
Phthalates								X		X
Ethyl tosylamide							X	X	X	
Triphenyl phosphate							X		X	
Lead								X		
Acetone									X	
Fragrance										X
Animal ingredients										X

"X" = reported to not contain

Challenges with Product Labels

Evolving labels:

- Labels are not consistently defined
- Implications for health are not well understood
- “Safe,” “Non-Toxic,” “Natural,” “Vegan” could be misinterpreted as safe

Challenges with Product Labels

Regrettable substitution of nail polish ingredients:

- 13 of the 20 nail polishes we studied disclose triphenyl phosphate (TPHP), an alternative plasticizer
  - None list DBP
- TPHP associated with:
  - Endocrine disruption
  - Reproductive and developmental concerns
  - Possible skin sensitization

(EPA 2017; Preston et al. 2017; Mendelsohn et al. 2016)

Challenges with Product Labels

Quality of products is not consistent:

- 5 of 6 tested "3-Free" nail polishes did contain one of Toxic Trio
- 10 of 12 toluene-free nail polishes did contain toluene, and often in higher concentrations

(Cal EPA DTSC, 2012)

TABLE 5. DIBUTYL PHTHALATE AND TOLUENE: PRODUCTS WITH TOXIC-TRIO RELATED CLAIMS VS. PRODUCTS WITHOUT ANY CLAIMS

Products	No. of Products	Dibutyl Phthalate				Toluene				
		% positive	Median	Average	Range	% positive	% with >10,000 ppm	Median	Average	Range
			ppm					ppm		
With Toxic-trio related claims	12	33	76,000	75,500	62,000-88,000	83	42	5,900	46,196	42-177,000
Without Toxic-trio related claims"	13	38	24,000	29,000	14,000-42,000	62	15	3,400	17,576	110-120,000

Next Steps for Pilot Projects

- Analyze nail polish samples for plasticizers and metals
- Compare analysis results with information from SDSs and labels
- Compare results with exposure assessment on workers:
  - Solvents: blood, breath, air
  - Plasticizers: urine, skin wipes, air
  - Metals: toenails

FUTURE STUDIES

- Assess effectiveness of interventions
  - Safer alternatives
  - Better controls
- Assess health effects of exposures
- Training and outreach

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